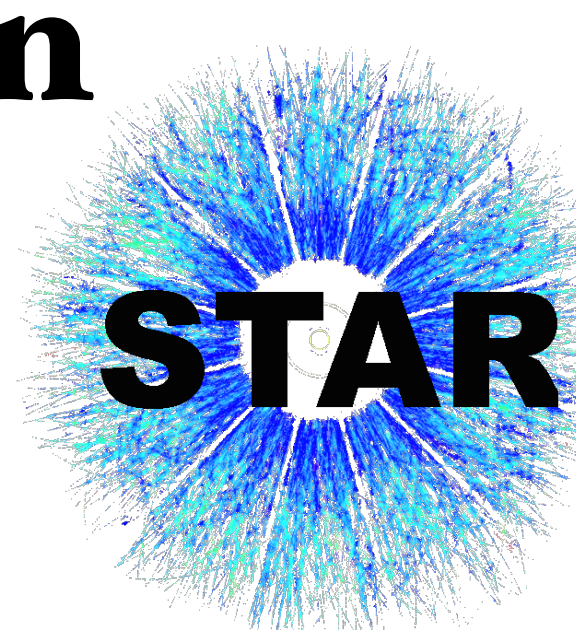


Measurement Of Longitudinal Single-Spin Asymmetry, A_L For W Boson Production In Polarized P+P Collisions At $\sqrt{s} = 510$ GeV At RHIC



INTRODUCTION

SPIN STRUCTURE OF THE PROTON

spin sum rule

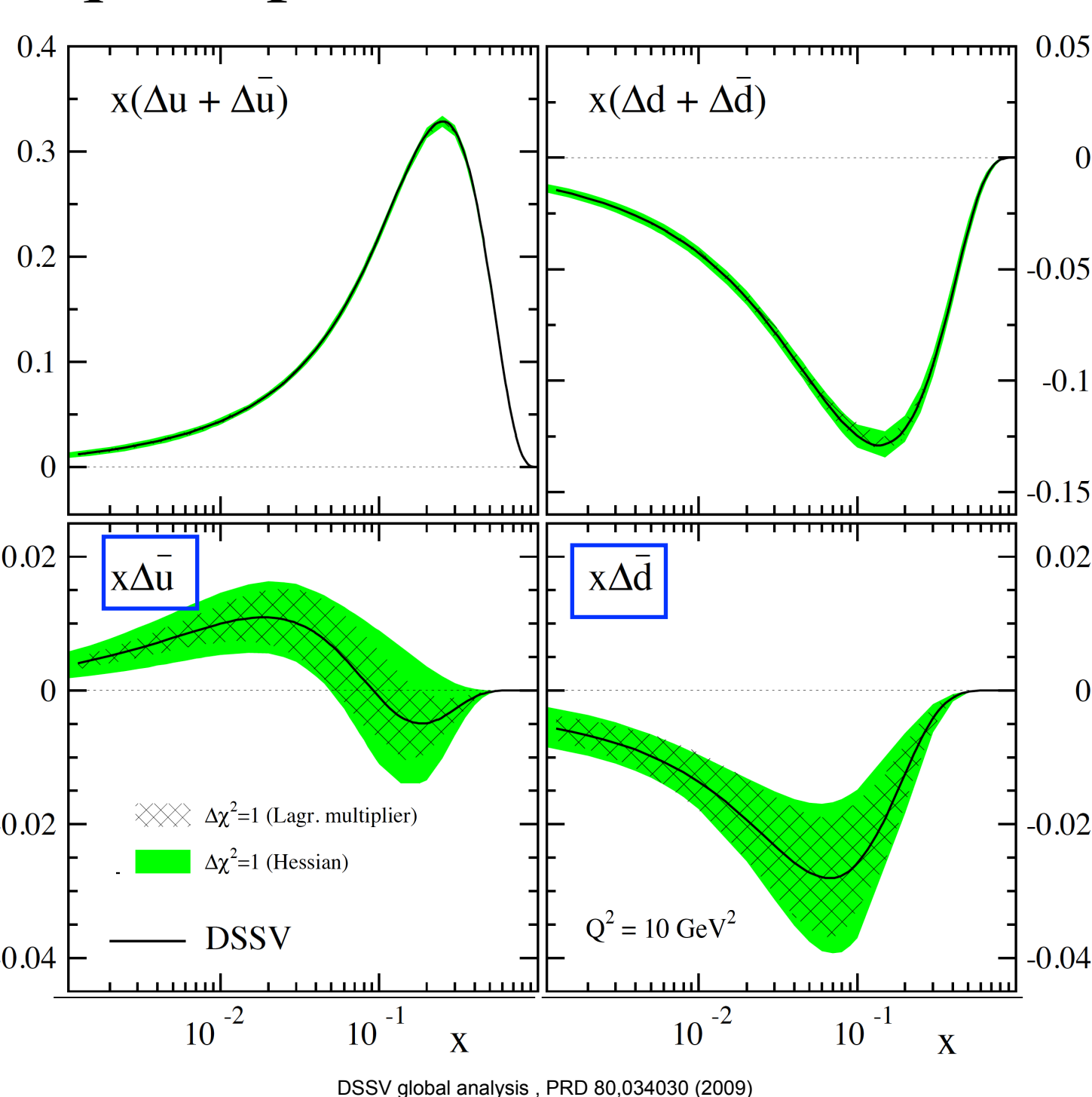
$$\langle S_p \rangle = \frac{1}{2} \left(\frac{1}{2} \Delta\Sigma + \Delta G + L \right)$$

Quark / antiquark Contribution

$$\Delta\Sigma = \int (\Delta u + \Delta d + \Delta s + \Delta\bar{u} + \Delta\bar{d} + \Delta\bar{s}) dx \quad \sim 30\%$$

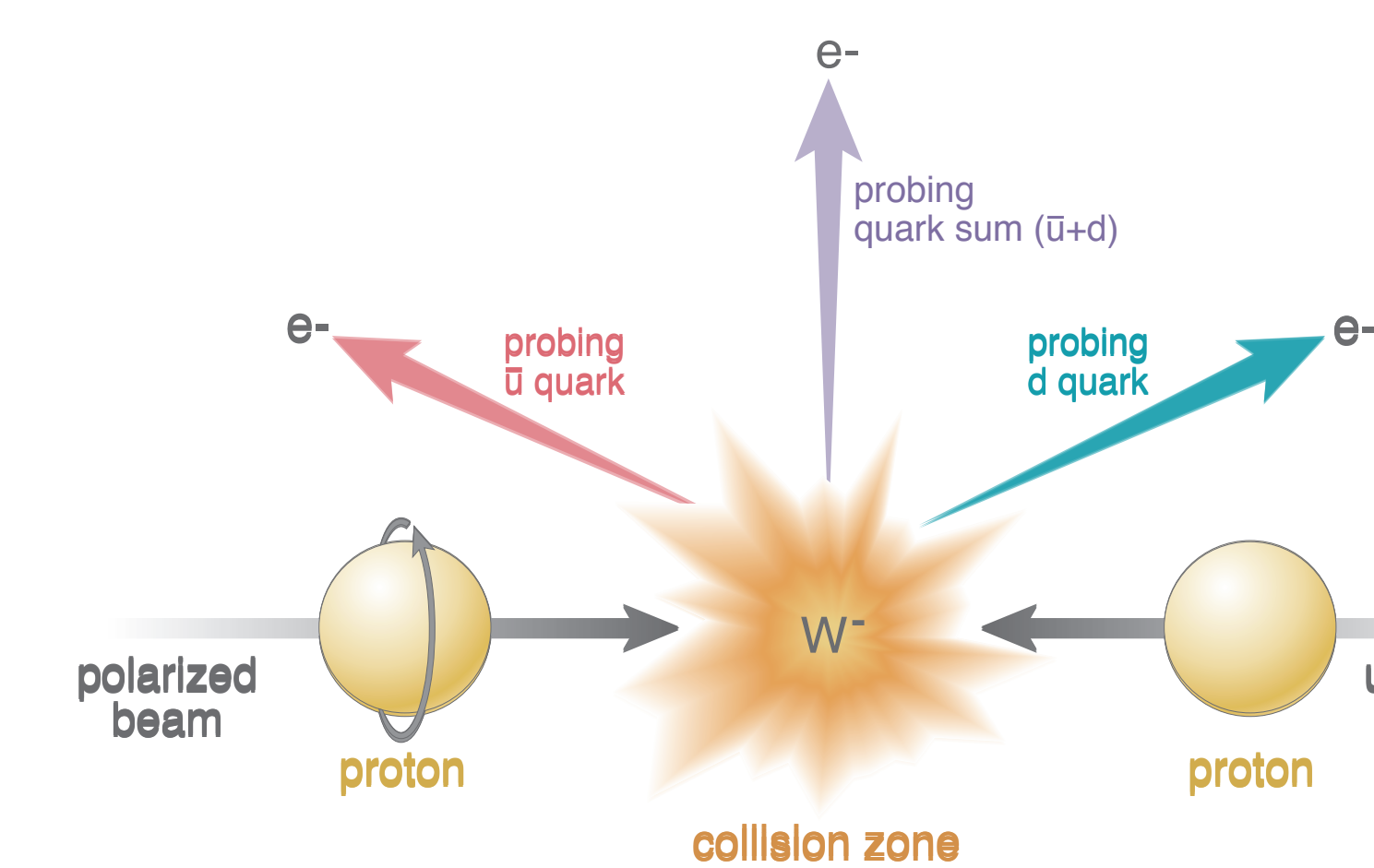
DSSV global analysis of helicity PDF

- Large uncertainty for sea quark polarization



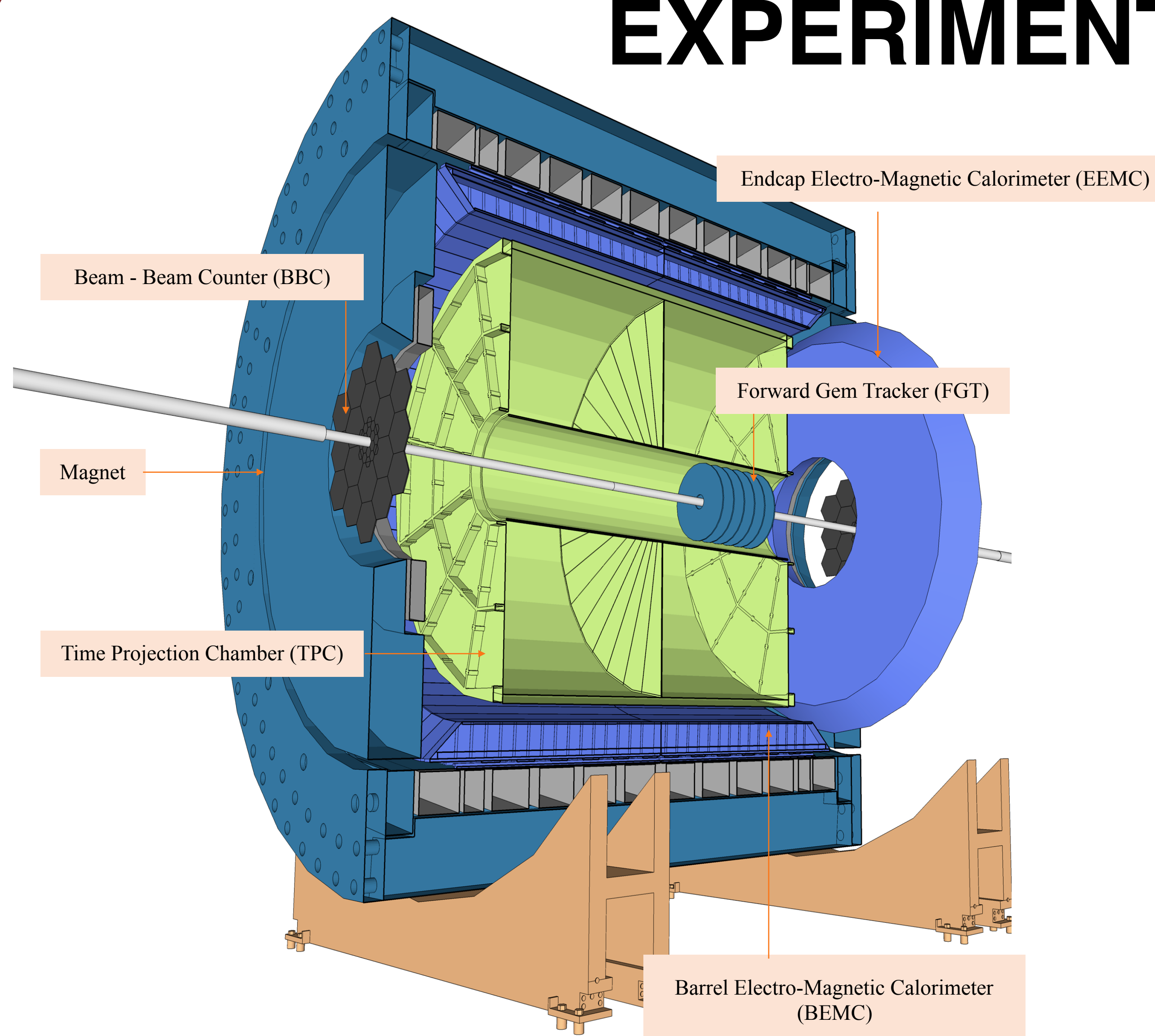
W Boson Production in polarized p+p collisions

- Direct access to $\Delta q / \Delta\bar{q}$
- Easy detection



- No fragmentation involve.
- Maximum parity violation

EXPERIMENT



STAR Detector

TPC : $-1.3 < \eta < +1.3$,
Tracking and Particle ID

BEMC : $-1.0 < \eta < +1.0$

EMC : $+1.1 < \eta < +2.0$

Barrel and Endcap 2π calorimetry

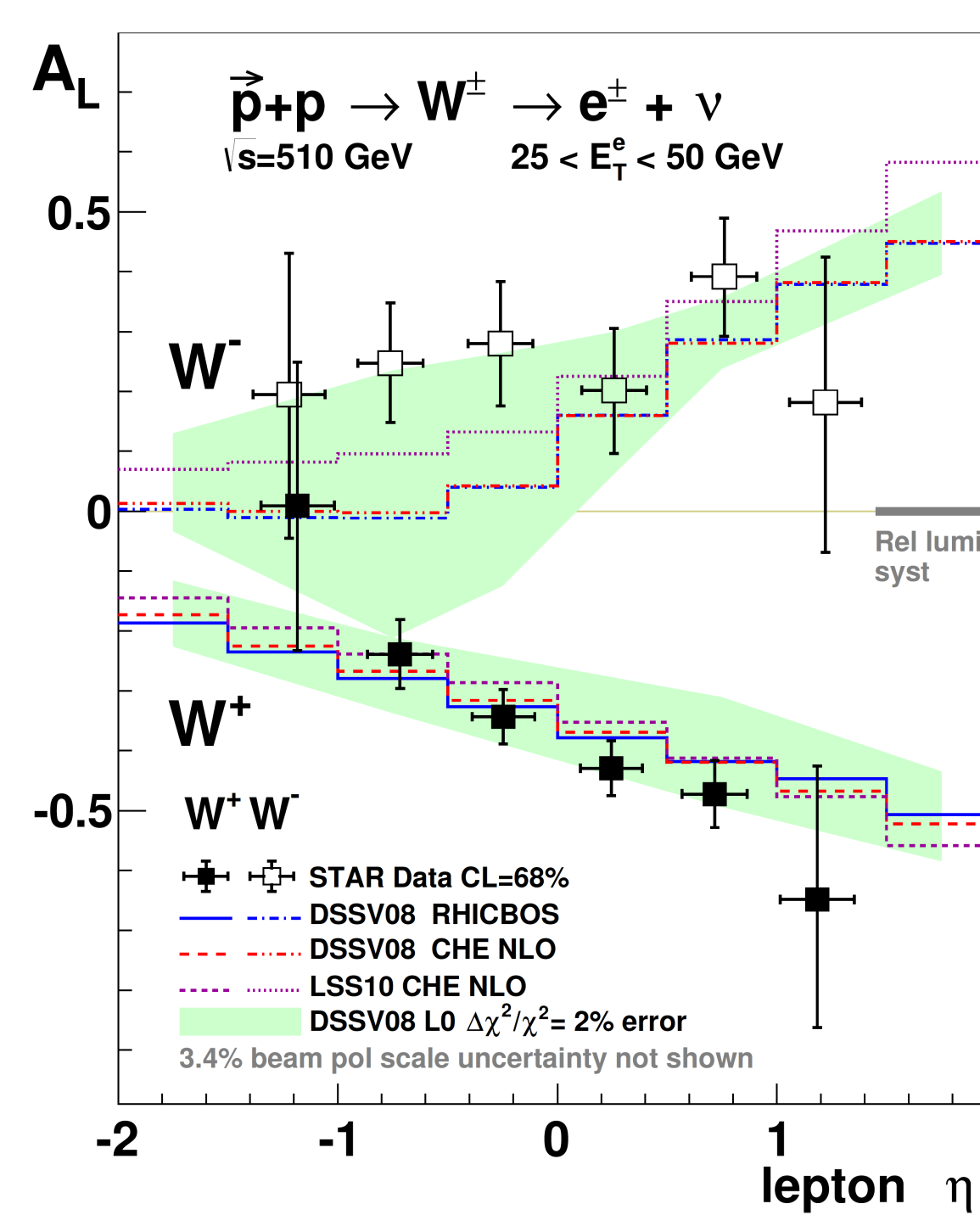
BBC / ZDC :

Relative Luminosity

RESULTS

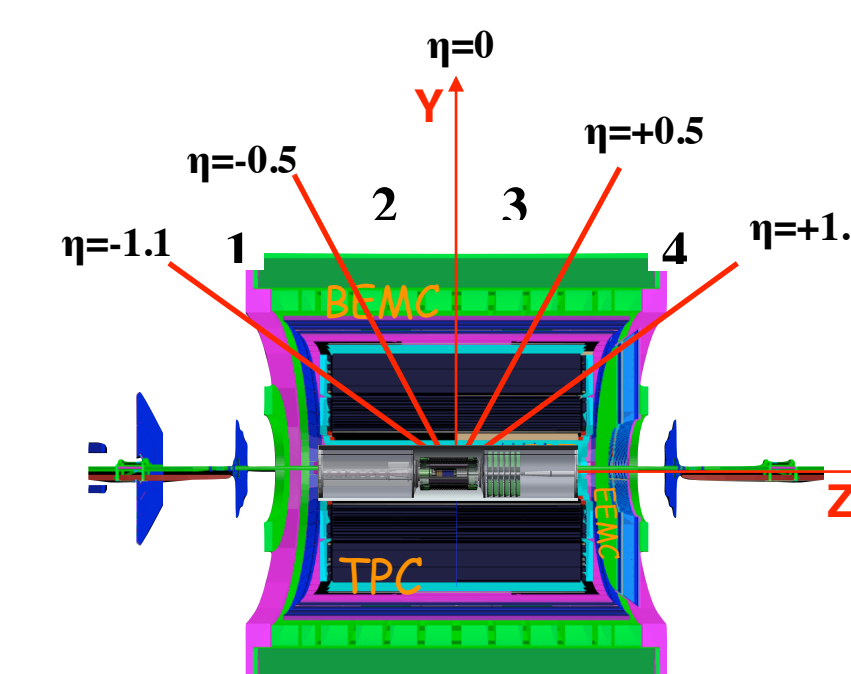
STAR Run 2012 W A_L Published Results

- Larger \bar{u} quark polarization than theoretical prediction



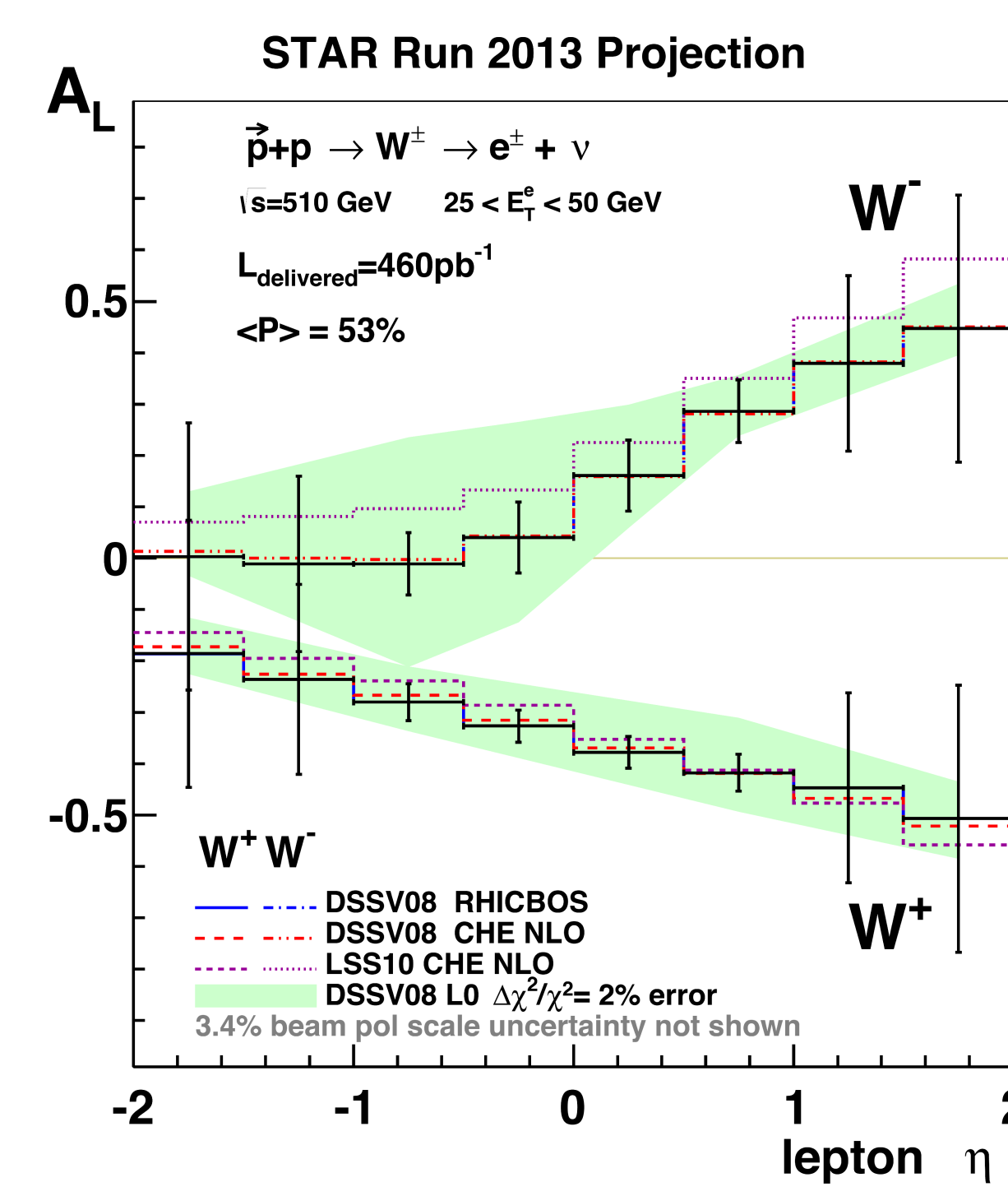
single spin asymmetry

$$A_L = \frac{\sigma^+ - \sigma^-}{\sigma^+ + \sigma^-}$$

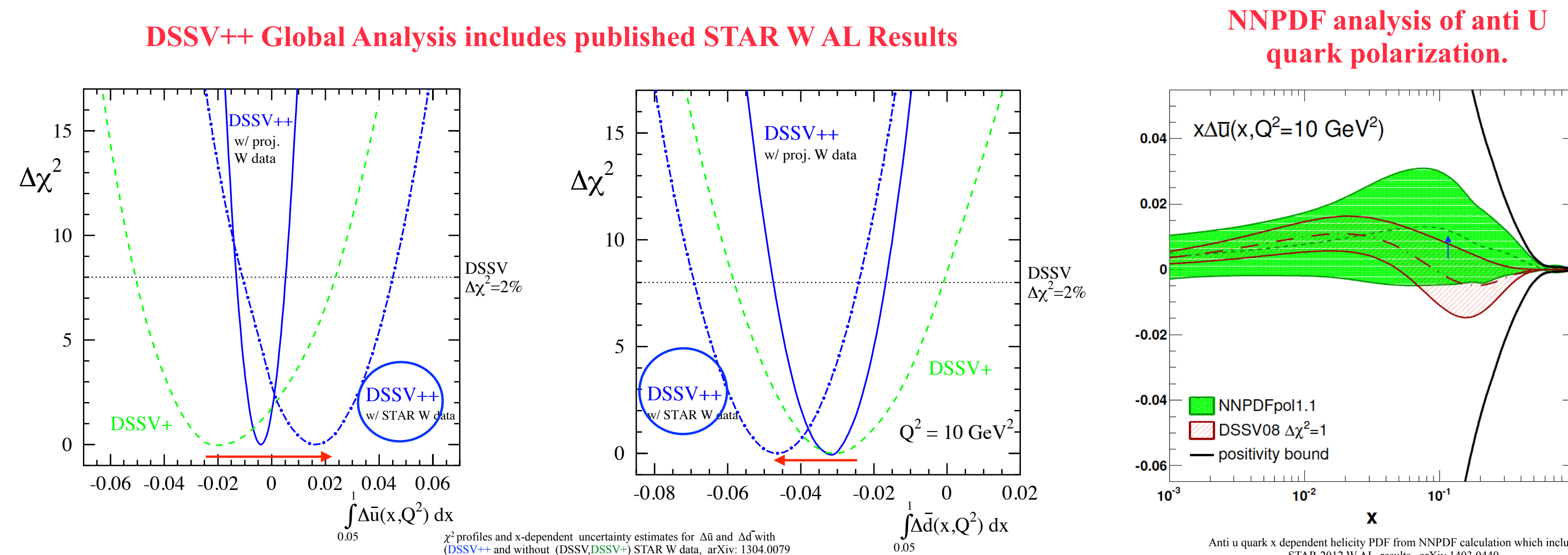


STAR Run 2013 W A_L Projections

- Large data set in run 2013 expect to reduce uncertainty further



Impact of Recent STAR W A_L Results on Recent Global Analyses and Predictions for future STAR Results



CONCLUSION

- The production of W bosons in polarized P+P collisions provides an excellent way to study the spin and flavor asymmetries of the proton quark and antiquark distributions.
- STAR has measured the parity violating single spin asymmetry A_L for pseudo-rapidity between -1.4 and +1.4 from STAR 2012 and 2011 data providing the first detailed look at the asymmetries η dependence.
- STAR 2012 W A_L results provide significant constraints on $\Delta\bar{u}$ and $\Delta\bar{d}$
- Large data set of STAR 2013 is being analyzed currently in mid rapidity region (pseudo-rapidity between -1.0 and +1.0) and expects results reduce uncertainty further.
- High precision results from STAR 2013 data will improve the constraints on the anti u and anti d quark polarizations.

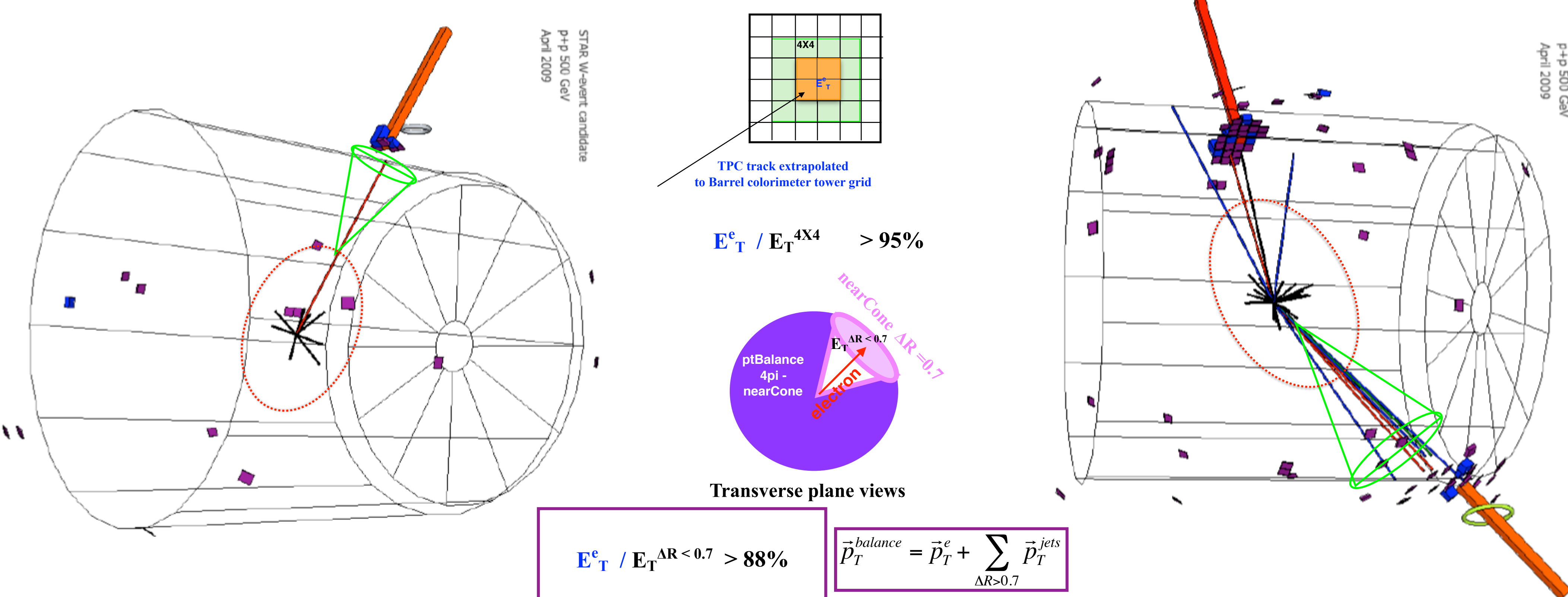
ANALYSIS

Reconstruction of W bosons from decay electron and positrons

- Isolated high energetic TPC tracks pointing to calorimeter tower. Energy from the maximum 2x2 cluster.
- Undetected neutrino leads to large opposite missing energy, large imbalance in the transverse momentum.
- Cuts designed to take the advantage of topological difference between W and QCD type BG event

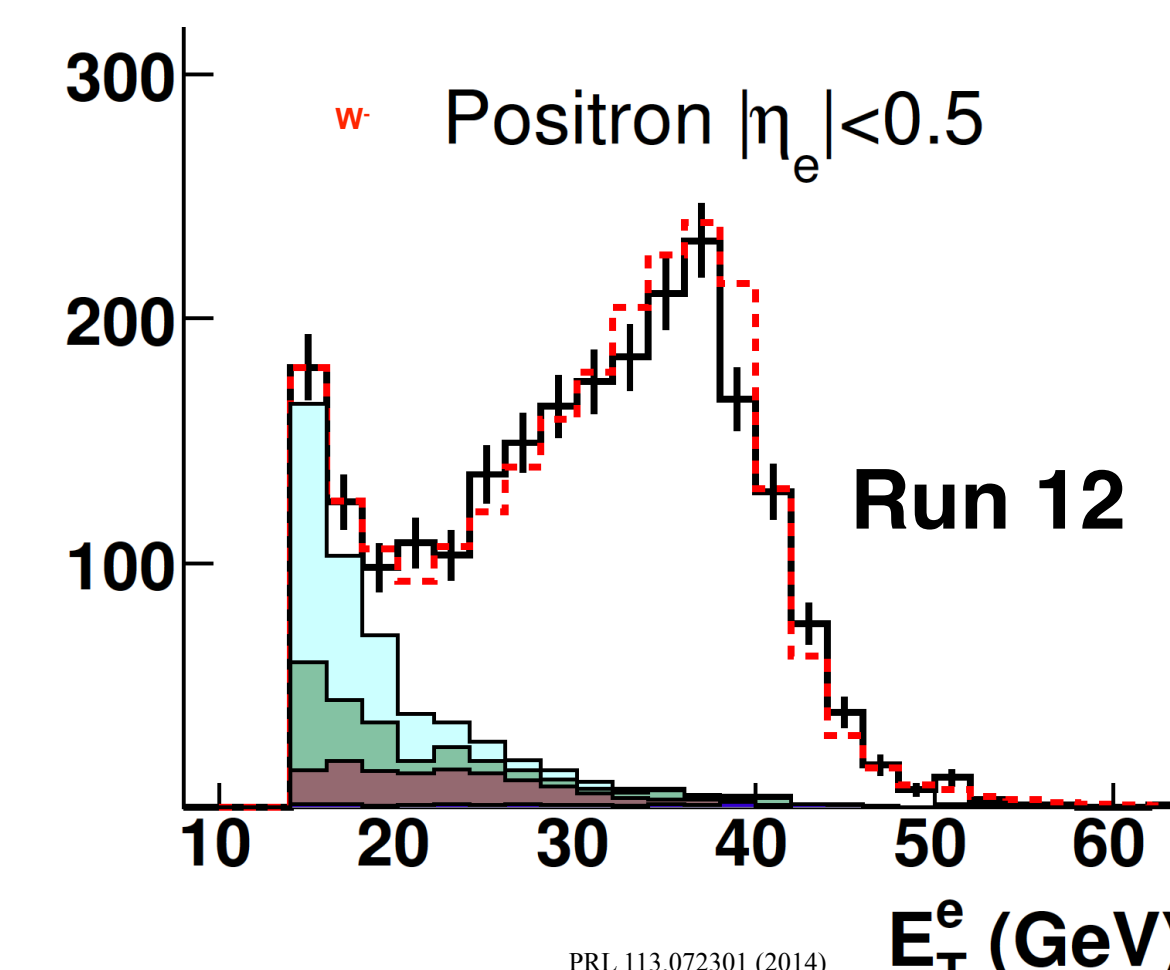
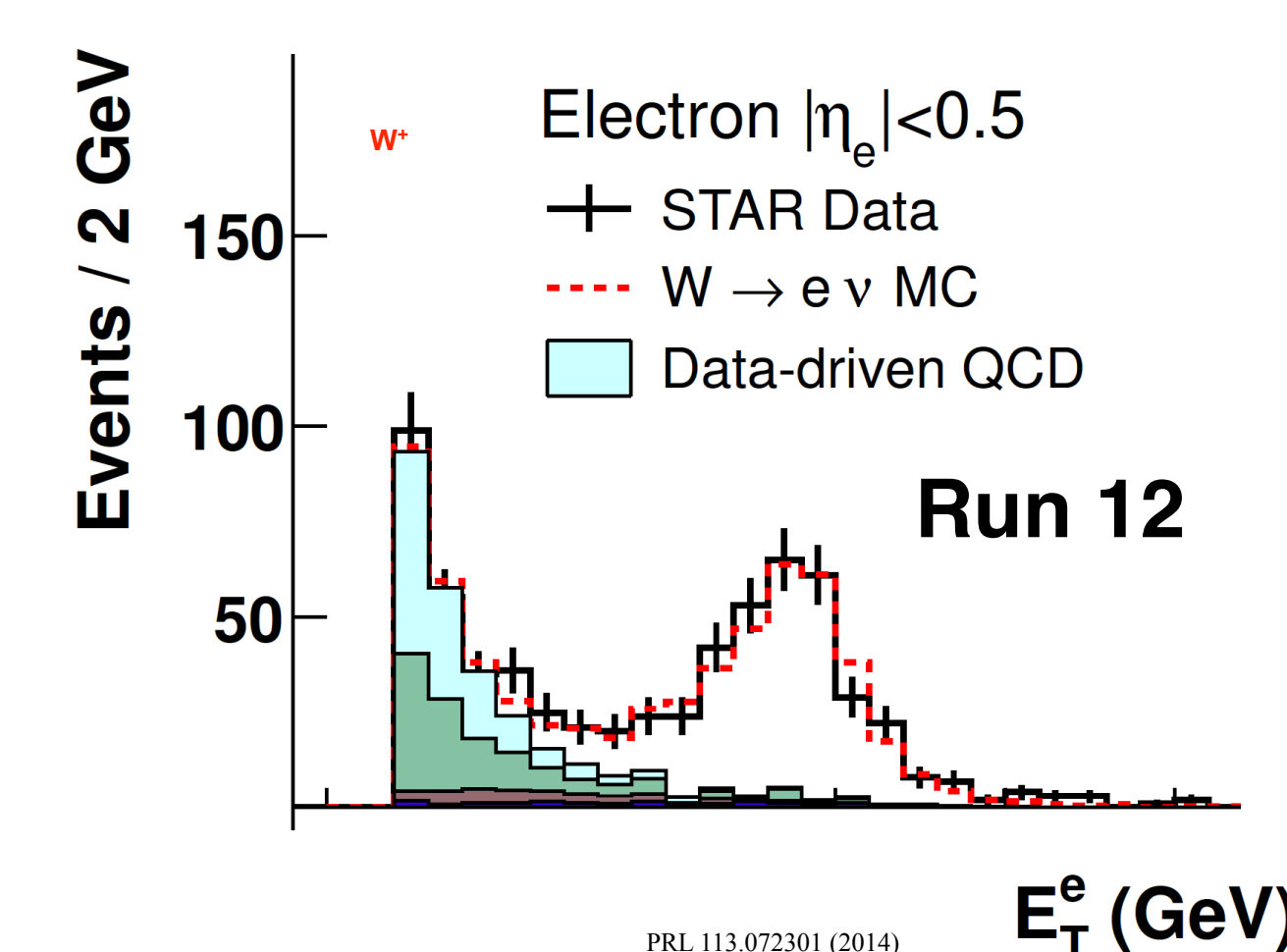
Calorimeter response from a simulated W event

Calorimeter response from a simulated QCD type di-jet background event

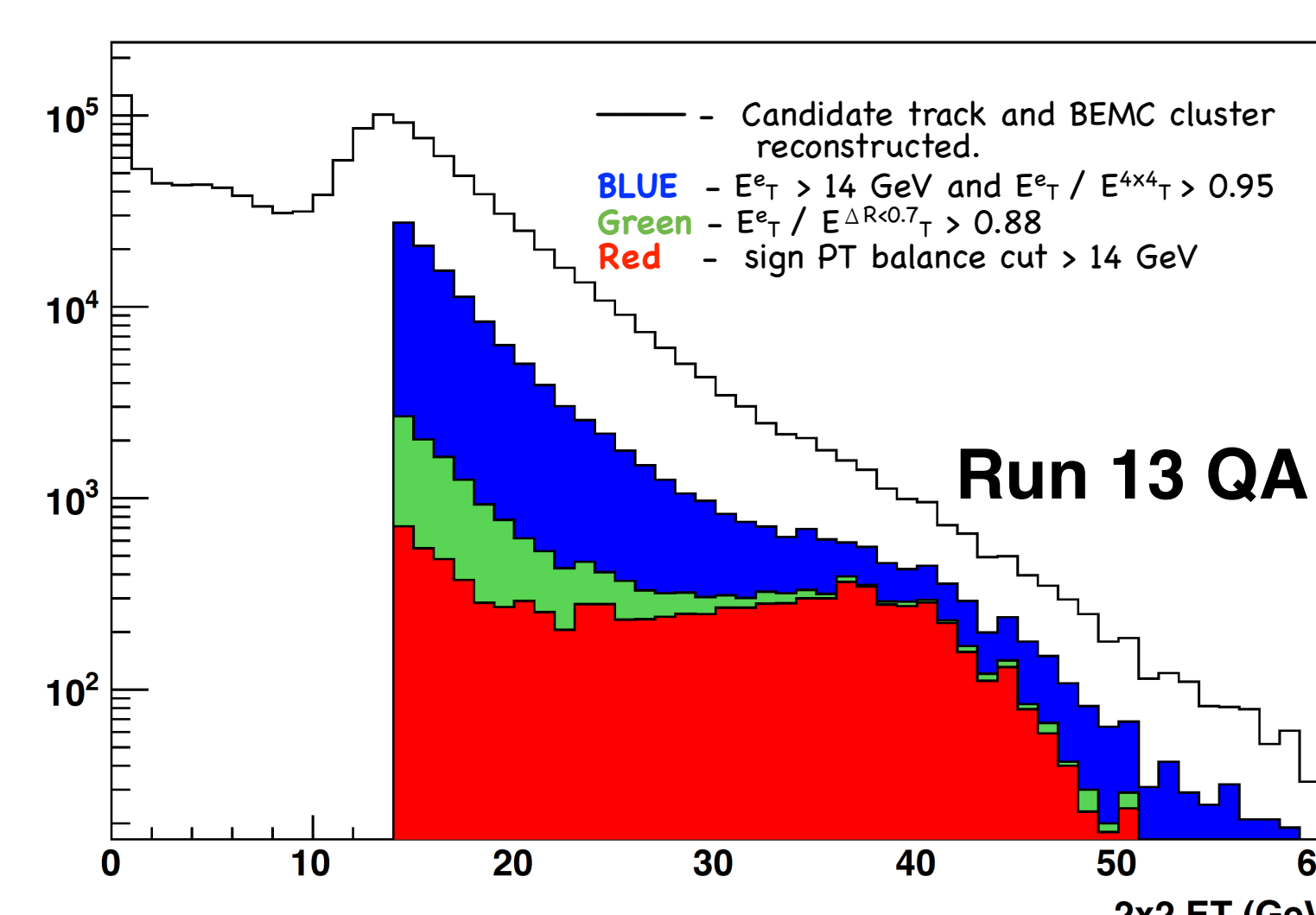


Background Estimation

- QCD BG using data driven procedure
- Electroweak BG ($W \rightarrow \tau, Z \rightarrow e^+e^-$) using MC simulation



W candidate tracks as a function of transverse Energy



TPC Charge sign separation

